REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
02-06-2009	FINAL REPORT	July 2008 - July 2009

4. TITLE AND SUBTITLE

Feasibility Study of a Blood Management Program in the Mike O'Callaghan Federal Hospital

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)

Fox, Steven M., Capt, USAF, MSC

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Mike O'Callaghan Federal Hospital
4700 N. Las Vegas Blvd
Las Vegas, NV 89191

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

U.S. Army Medical Department Center and School
Bldg 2841 MCCS-HFB (Army Baylor Program in Health and Business Administration)
3151 Scott Road, Suite 1411
Fort San Houston, TX 78234-6135

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

33-09

12. DISTRIBUTION / AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited

13. SUPPLEMENTARY NOTES

Feasibility Study, Blood Management

14. ABSTRACT

This study examines the feasibility and potential benefits of implementing a blood management program at the Mike O'Callaghan Federal Hospital (MOFH). The study evaluated two major courses of action for potential implementation of blood utilization practices. Analyses indicated that implementation of a full-scale program in the surgical setting would not significantly impact the MOFH from a strict cost-benefit standpoint. In the medical services segments, however, implementing consistent, evidence-based peer review procedures and eliminating autologous donations could potentially save the MOFH more than $120,000 over the next three years. Integral to the potential savings is the initiation of a blood management committee. The oversight and guidance provided by the committee would be the driving force for reducing the number of allogeneic transfusions occurring in the facility. Fewer transfusions correlate to fewer transfusion reactions, reduced risk of infection, and fewer surgical complications. Reducing the number of transfusions will have widespread benefits for both patient safety and the bottom line of the MOFH. Following through with the blood management committee recommendation also opens the door for several future studies which could also provide financial and operational benefits to the MOFH.

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE	---		Education Technician
U	l				

19b. TELEPHONE NUMBER *(include area*

:1-6443

ard Form 298 (Rev. 8-98)
ed by ANSI Std. Z39.18

Running head: FEASIBILITY OF BLOOD MANAGEMENT

Feasibility Study of a Blood Management Program in the Mike O'Callaghan Federal Hospital

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Army-Baylor University Graduate Program in Health and Business Administration

Acknowledgements

The author would like to thank Lieutenant Colonel Craig Mauch for his guidance, flexibility, and understanding throughout the course of this endeavor. I also owe a big debt of gratitude to Major Paul Brezinski for his constant support and timely, valuable feedback. There are a number of team members from the Mike O'Callaghan Federal Hospital without whose help I could not have completed this project. Major Theodore Walker provided great perspective into blood utilization in the surgical department. Staff Sergeant Kenneth Sayer was a constant source of great information. Major Joan Hoyte's resourcefulness and data analysis were indispensable while developing the model for this business case. Additionally, Ms. Janet Genter, Laboratory Director for MountainView Hospital in Las Vegas, provided me with invaluable insight into the practical application of a blood management program.

Abstract

This study examines the feasibility and potential benefits of implementing a blood management program at the Mike O'Callaghan Federal Hospital (MOFH). The study evaluated two major courses of action for potential implementation of blood utilization practices. Analyses indicated that implementation of a full-scale program in the surgical setting would not significantly impact the MOFH from a strict cost-benefit standpoint. In the medical services segments, however, implementing consistent, evidence-based peer review procedures and eliminating autologous donations could potentially save the MOFH more than $120,000 over the next three years. Integral to the potential savings is the initiation of a blood management committee. The oversight and guidance provided by the committee would be the driving force for reducing the number of allogeneic transfusions occurring in the facility. Fewer transfusions correlate to fewer transfusion reactions, reduced risk of infection, and fewer surgical complications. Reducing the number of transfusions will have widespread benefits for both patient safety and the bottom line of the MOFH. Following through with the blood management committee recommendation also opens the door for several future studies which could also provide financial and operational benefits to the MOFH.

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Introduction

Mike O'Callaghan Federal Hospital

The Mike O'Callaghan Federal Hospital (MOFH) is a 104-bed hospital located on Nellis AFB, Nevada. Nellis AFB is situated on the northeast side of Las Vegas, Nevada. The MOFH is home to the 99th Medical Group. The 99th Medical Group is part of the 99th Air Battle Wing, which falls under Air Combat Command. Nellis is also home to the United States Air Force Warfare Center. The MOFH is a joint venture Federal health care facility that integrates medical resources from the Department of Defense (DoD) and the Department of Veteran's Affairs (VA). The MOFH, through its staff of over 1,400 military, civilian, contract, and VA employees, supports one of the largest beneficiary populations in the Air Force. The joint venture provides medical support to a population of over 73,000 eligible DoD beneficiaries and more than 240,000 eligible VA beneficiaries (99th Medical Group, 2007). The MOFH averages as many as 2,000 outpatient visits a day and performs as many as 30 inpatient and ambulatory surgeries per day.

The mission of the MOFH is to "deliver safe, customer-oriented, prevention-focused, efficient, quality healthcare while maximizing worldwide military readiness." The MOFH vision is to "transition our integrated DoD/VA system to the world-class model for other federal healthcare partnerships" (99th Medical Group, 2007). The MOFH works toward these objectives by providing a multitude of outpatient and inpatient services and specialties. The MOFH also provides advanced medical training in a variety of disciplines, including but not limited to physician assistants, dental residents, general surgery residents, and certified registered nurse anesthetists. The MOFH initiated a Family Medicine Residency program in the early part of 2009.

Core and Project Teams

The Project Team consisted of several staff members from the MOFH in addition to the Army-Baylor Program student administering this business case analysis. The project team members that contributed to the analysis were:

Major Theodore Walker, Surgical Services

Maj Hoyte, Group Practice Manager

Lt Col Mauch, Medical Support Squadron Commander

SSgt Kenneth Sayer, MOFH Laboratory

Ms. Kathy Nagy, MOFH Laboratory

Subject of the Case

An opportunity may exist to save money and optimize patient safety by evaluating and organizing the blood management efforts in the MOFH. Leadership expects the scope of services at the facility to increase in the future; consequently, the workload in the operating room and blood utilization rates, which have among the highest in the Air Force Medical Service, should also increase. The focus of this study is to determine, through a modified version of a business case analysis, if the advantages of implementing a blood management program outweigh the potential costs.

There will always be a need for donated blood. However, numerous events, from the September 11th attacks to a tainted blood scandal that left thousands in Canada infected with HIV and Hepatitis C, have caused a shift in recent years toward increased use of "bloodless" techniques (Seeber, 2007; Nichols, 2000). The Society for the Advancement of Blood Management defines blood management as the appropriate provision and use of blood, its components and derivatives, and strategies to reduce or avoid the need for a blood transfusion

(Society for the Advancement of Blood Management, 2008). This analysis examines the likely costs and benefits associated with implementing a blood management program in the MOFH. The primary objective of this proposal, consistent with the mission of the MOFH, is to improve patient outcomes using measures that reduce or eliminate the need for allogeneic blood transfusions. Any improvement must consider the potential costs and effectiveness of new processes or equipment. Costs examined during the course of these analyses will utilize data from previous years to project the financial, productivity, and clinical impacts of blood management techniques. Because the institution of a full-scale program will affect all medical services functions of the MOFH, these analyses will examine the costs, benefits, and impacts within both the surgical services department and the medical services departments.

The analysis completed in support of this project will progress through five distinct phases. The first section will provide a basic overview of blood management, identifying the techniques, procedures, processes and resources that could potentially be required to initiate and maintain a blood management program. The next stage will consist of an outline of the current operations at the MOFH relative to the blood management principles outlined in the first segment. The third phase will consist of an integrative assessment of phases one and two, ultimately defining what would constitute a blood management program for the MOFH. Next, analyses will evaluate potential courses of action, comparing the suggested blood management program against maintenance of the status quo. Finally, conclusions and recommendations stemming from the analyses will provide the MOFH commander with decision support for possible implementation of blood management in the facility.

Purpose

The purpose of this business case analysis is to provide the 99th Medical Group Commander the assessments and projections necessary to make a decision regarding whether implementation of a blood management program at the MOFH will help fulfill the organization's patient-focused mission. While the business case analysis focuses on just the MOFH, this research could potentially serve as a resource for other military treatment facilities to evaluate the viability of a structured blood management program.

Background

While the military has a long history of advancing blood management, its primary focus has been in trauma/battlefield settings with the most recent effort being collaboration with the Society for the Advancement of Blood Management following the September 11th attacks (Seeber, 2007). The Strategies to Reduce Military and Civilian Transfusions (STORMACT) initiative developed from the military's awareness that the high cost of transfusion and the logistic challenges of blood storage required new approaches to blood conservation in both disaster and preclinical settings. For example, is can cost as much as $9000 to transfuse in a country like Afghanistan (Seeber, 2007).

A comprehensive search of military and medical journals, as well as communication with knowledgeable Air Force Medical Service professionals, yielded no literature on any full-scale, comprehensive documented blood management programs at the military treatment facility level. Air Force treatment facilities adhere to the guidelines outlined in Air Force Instruction 44-105, The Air Force Blood Program. This instruction integrates Food and Drug Administration (FDA) regulations with the Armed Forces Blood Program. Although AFI 44-105 has a broad scope and focuses primarily on the collection and transportation of blood products to the end users in peacetime and during war, there are several key points from the instruction that are relevant to

this study. First, the instruction details the importance of inventory maintenance – an indication of the value and scarcity of blood as a health care resource. Secondly, the instruction recommends that alternative interventions or transfusion of synthetic or processed blood products that do not pose disease transmission risks should be considered first (AFI 44-105). Because most of the available literature on blood management in military facilities focuses beyond the facility level, this literature review uses research and analyses from civilian health care settings to form the basis for decision support on the potential initiation of a blood management program in the MOFH. It will cover the history, growth, potential costs, and proposed benefits of blood management programs.

The blueprint for this proposal, and one of the seminal works in blood management, is the book Basics of Blood Management (Seeber, 2007). The book provides a comprehensive overview of blood management. It explores the biological, philosophical, physiological, and ethical considerations as well as practical applications of blood management. This text provides background and insight. It is one of the most all-inclusive sources of information on blood management. As more evidence becomes available about the increased risks of transfusion, the incentive to apply blood management increases. Doctors warn that more than half of blood transfusions may do more harm than good, with some patients facing a six-fold greater risk of dying following surgery because of transfusions (Sample, 2008). In addition, mortality rates increase the longer blood is stored prior to transfusion, with an increase in mortality occurring when the transfusion occurs after the two-week threshold (Koch, Sessler, Figueroa, Hoeltge, Mihaljevic, Blackstone, 2008). In one study, patients transfused with "old blood" (two weeks or older) were deemed to have a 30% increase in relative risk of postoperative death (Koch, Sessler, Figueroa, Hoeltge, Mihaljevic, Blackstone, 2008). Data like this indicates more judicious use of

transfusion is essential to improving outcomes and quality of care. Another factor to consider is anemia. Proponents often cite improved patient outcomes, reduced risk of infection, and cost savings as three legitimate benefits to implementing a blood management program (Society for the Advancement of Blood Management, 2008). Depending on the demographics of the patient population, anemia can be present in as many as 50% of surgical patients (Jaspan, 2007). A number of the processes and techniques discussed in the research address the potential benefits of blood management to anemic patients. The implications of these studies support the blood management techniques outlined in this project.

Techniques in the Surgical Setting

Discussions of blood management and blood conservation programs consistently recommend a handful of common techniques including, but not limited to, erythropoietin therapy, the use of blood substitutes, and hemodilution (Nichols, 2000; Rothenburg, 1998; Waters, 2004). At the heart of the discussion of blood management programs is a patient-centered focus consistent with the MOFH's outlined mission. There are several key principles shared by most of the blood management programs currently in existence and recommended by those with the most experience in the field. A comprehensive program includes techniques to conserve and manage blood in the preoperative setting, intraoperative setting, and postoperative setting.

Preoperative setting: In the preoperative setting, techniques to reduce the need for transfused blood include iron therapy, diet modification, and erythropoietin therapy (Waters, 2004). Erythropoetin is a chemical designed to stimulate the body's bone marrow to produce red blood cells. Erythropoetin therapy is often used in combination with the administration of intravenous iron in preoperative and postoperative settings. The most commonly used agent for

erythropoietin therapy is epoetin alfa. These two therapies have proven effective at reducing anemia and increasing hemoglobin levels in patients preparing for surgery especially in circumstances where the therapy can be initiated two to three weeks in advance of the surgical procedure. (Theusinger, Leyvraz, Schanz, Seifert, Spahn, 2007; The Joint Commission, 2007). In fact, a 2000 study of patients undergoing radical prostatectomies evaluated the effectiveness of epoetin alfa at reducing allogeneic transfusion. In the study, 90% of patients did not require allogeneic transfusion, and that is for a procedure with a historical transfusion requirement of up to seven units in over 50% of patients (Rosenblum, N., Levine, M., Handler, T., & Lepor, H, 2000).

Autologous donation is another measure recommended in the preoperative setting. Preoperative Autologous Donation (PAD) refers to the collection of the patient's own blood for use, if necessary, during the surgical procedure. This process eliminates reactions due to donor incompatibility and also mitigates exposure to transfusion related infection. Some other benefits of PAD include the instant accessibility without requirement for a crossmatch and the ability to overcome taboos and prohibitions of allogeneic blood transfusions associated with certain religious beliefs. While side effects to PAD are minimal, to avoid fatigue, dizziness, or other complications, the process should be standardized and conducted under a doctor's supervision.

Intraoperative setting: In the intraoperative setting, some of the key elements of a blood management program include acute normovolemic hemodilution (ANH), cell salvage, use of plasma volume expanders, and the use of hemostatic drugs (Physicians and Nurses for Blood Conservation, 2008). Hemodilution involves the removal of up to four pints of blood – bolstered with erythropoietin or blood substitutes just before surgery – and replacement with four pints of saline solution. This reduces the loss of the patient's actual blood and, following surgery, the

patient is reinfused with his or her enriched blood. An added benefit to this process is that donating four pints of blood right before surgery is much more cost effective than storing it in a blood bank for several weeks (Rothenberg & Barrett, 1998). This process also eliminates the possibility for a transfusion mistake, as the blood does not leave the operating room. The most recent studies on the effectiveness of ANH are inconclusive regarding its effect on patient outcomes, but the procedure does reduce the risk of postoperative infection and reduce the need for allogeneic blood transfusion by as much as 30%, although not to the level of statistical significance (Segal, 2004; Matot, Schenin, Jurim, Eid, 2002; Bennett, 2006). The lack of definitive conclusions in two of the major studies was directly attributable to clinicians' failure to follow transfusion protocols. In two of the studies, if transfusion protocols had been met, the efficacy of ANH in reducing allogeneic transfusions would have met statistical significance (Bennett, 2006; Casati, 2006). Other prevalent intraoperative techniques include surgical instruments such as gamma knives and harmonic scalpels as well as high intensity focused ultrasound (McCarthy, 1999). One of the benefits of newer surgical instruments is the ability to minimize blood loss during the surgical procedure. Keeping blood volume as normal as possible is a primary tenet of blood management as surgical red blood cell loss is a leading predictor of allogeneic blood transfusion (Gambotz, Rehak, Shander, & Hofman, 2007).

Postoperative setting: Postoperative strategies generally refer to the continuation of those previously mentioned, such as iron therapy. The use of particular strategies is largely dependent on the patient and the type of surgery, but the primary goal remains to limit allogeneic transfusion to the greatest extent possible. What follows is a more in-depth analysis of the variety of mechanisms available for inclusion in a comprehensive blood management program.

Regardless of the techniques that an organization selects for a blood management program, one of the key facets of program implementation is connecting with the target audience through various patient education measures. Northeast Baptist Hospital in San Antonio, Texas developed a blood management newsletter to coincide with the initiation of their bloodless surgery program. The hospital used its inaugural newsletter to educate its patients on the four pillars of anemia therapy and the reason for the transition to bloodless surgery (Northeast Baptist Hospital, 2008). The newsletter also included a transcript from a local news story on their program, a clever integration of patient education and marketing.

One of the practices gaining significant momentum in the effort to reduce transfusions is a tightening of the transfusion trigger points. This is especially apparent in regards to red blood cells. Traditionally, triggers for transfusions are based on a patient's hemoglobin, as measured in grams per deciliter, and Hematocrit, measured as a percentage of blood volume occupied by red blood cells. Historically, red blood cell transfusions have used 10 grams per deciliter as a consistent hemoglobin trigger for red blood cells in the absence of any other clinical indicators (Goodnough, Shander, & Spence, 2003). More recently, research has demonstrated the viability of reducing the hemoglobin trigger without detrimentally affecting the patient's safety or the quality of patient outcomes. In one of the more commonly cited studies, a randomized controlled clinical trial, a hemoglobin threshold of 7 grams per deciliter for red blood cells was demonstrated to be just as safe and effective as a more liberal strategy with a threshold of 10 – 12 grams per deciliter (Hebert, Wells, Blajchman, Marshall, Martin, Pagliarello, et al., 1999).

Once implementation of a blood management program occurs, it is vital to track indicators of the success of the program. Again, metrics can provide vital information from both patient-centered and economic efficiency perspectives. Several health care organizations

measure length of stay reductions, percentage of patients requesting bloodless surgery, and cost savings per procedure as indicators of effectiveness of their blood management programs (Shinkman, 1998). Some other key outcome measurements utilized in blood management programs include readmission rate, patient satisfaction, mortality, and blood utilization rate (Ratcliffe, 2004). Finally, one of the more relevant aspects of blood management to military health care is its application in a trauma setting. Recent research suggests a successful blood management program can be implemented in a trauma setting (Crum, 2007). The key to every aspect of program development, strategies, techniques, and measurement is close coordination with the staff and management at every level of the process.

Methods and Assumptions

Current Status

There appears to be significant opportunity to establish a comprehensive blood management program at the MOFH. Based on interviews with members of numerous departments within the MOFH, as well as reviews of clinical records, blood bank reports, and meeting minutes, it is clear that the current approach to blood management does not consistently utilize some of the techniques outlined earlier in previous research. In some cases, such as with acute normovolemic hemodilution, there is no effort at the MOFH to utilize techniques with the demonstrated potential to provide similar, if not superior, clinical and financial outcomes. As of January 2009, the MOFH is the second highest transfusing facility in the Air Force Medical Service, with only Wilford Hall Medical Center, in San Antonio, Texas, transfusing more blood (Air Force Medical Operations Agency, 2009). As the MOFH continues to grow, and the number of procedures in the operating room increases, so does the potential benefit to having an organized blood management program.

Currently, medical services, maternal care, family practice, and the emergency department account for over 75% of the transfusions that occur in the MOFH, while less than 25% come from the surgical services (Tables 1 – 3). This ratio is slightly inconsistent with hospitals in the civilian sector, in which the trend is toward a closer balance between transfusions administered to surgical patients and those administered to medical patients (Paxton, 2008). The MOFH's historical blood utilization numbers and rates provide the baseline data projections moving forward. Table 1 provides the transfusion data for calendar year 2006.

Table 1. MOFH Transfusion Data, 2006

	Medical Services	Surgical Services	Maternal Child	Fam Prac ER	YEARLY Total
1 # Patients Typed & Screened	44	62	868	85	1059
2 # Units Crossmatched (Homologous)	978	732	66	242	2018
3 # Units Transfused (Homologous)	764	327	29	175	1295
4 Crossmatched:Transfusion Ratio, ___:1	1.28	2.24	2.28	1.38	1.56
5 Utilization Rate (Homologous)	78%	45%	44%	72%	64%
6 # Patients Transfused	279	104	10	80	473
7 # Single unit Transfusions	18	6	0	8	32
8 # Units Fresh Frozen Plasma	242	92	4	14	352
9 # Units Pheresis Platelets	52	37	0	2	91
10 # Units Cryo:	20	30	0	0	50
11 # Autologous units Crossmatched	2	23	0	0	25
12 # Autologous units Transfused	2	18	0	0	20
13 # Autologous units Out-dated	0	5	0	0	5
14 # RBC units wasted	4	5	0	0	9
15 # FFP units wasted	14	16	0	0	30
16 # Pheresis Platelet units wasted	4	4	0	0	8
17 # Units emergency released	1	6	1	5	13
18 # Units Shipped (West L.A VA)					116

It is important to note that the Medical Services department accounted for the majority of the transfusions in 2006. Table 2 provides the 2007 transfusion data, which reinforces the trend toward higher transfusions totals for the Medical Services rather than for Surgical Services.

Table 2. MOFH Transfusion Data, 2007

	Medical Services	Surgical Services	Maternal Child	Fam Prac ER	YEARLY Total
1 # Patients Typed & Screened	61	83	902	89	1135
2 # Units Crossmatched (Homologous)	895	582	72	333	1882
3 # Units Transfused (Homologous)	756	255	30	246	1287
4 Crossmatched:Transfusion Ratio, ___:1	1.18	2.28	2.40	1.35	1.46
5 Utilization Rate (Homologous)	84%	44%	42%	74%	68%
6 # Patients Transfused	280	92	16	112	500
7 # Single unit Transfusions	26	6	4	10	46
8 # Units Fresh Frozen Plasma	71	65	1	23	160
9 # Units Pheresis Platelets	201	9	0	11	221
10 # Units Cryo:	0	0	0	0	0
11 # Autologous units Crossmatched	0	27	0	0	27
12 # Autologous units Transfused	0	17	0	0	17
13 # Autologous units Out-dated	0	10	0	0	10
14 # RBC units wasted	1	10	0	0	11
15 # FFP units wasted	15	5	1	0	21
16 # Pheresis Platelet units wasted	9	3	0	0	12
17 # Units emergency released	1	5	0	4	10
18 # Units Shipped (West L.A VA)					40

The third table provides the transfusion data and rates for the year 2008, which were relatively consistent with results from the previous two years.

Table 3. MOFH Transfusion Data, 2008

	Medical Services	Surgical Services	Maternal Child	Fam Prac ER	Monthly Total
1 # Patients Typed & Screened	55	201	851	103	1210
2 # Units Crossmatched (Homologous)	955	442	66	302	1765
3 # Units Transfused (Homologous)	798	225	29	231	1283
4 Crossmatched:Transfusion Ratio, ___:1	1.20	1.96	2.28	1.31	1.38
5 Utilization Rate (Homologous)	84%	51%	44%	76%	73%
6 # Patients Transfused	285	64	13	105	467
7 # Single unit Transfusions	22	1	1	7	31
8 # Units Fresh Frozen Plasma	102	106	4	14	226
9 # Units Pheresis Platelets	80	36	0	9	125
10 # Units Cryo:	2	4	0	0	6
11 # Autologous units Crossmatched	0	10	0	0	10
12 # Autologous units Transfused	0	10	0	0	10
13 # Autologous units Out-dated	0	1	0	0	1
14 # RBC units wasted	5	1	0	0	6
15 # FFP units wasted	6	11	2	4	23
16 # Pheresis Platelet units wasted	3	2	0	0	5
17 # Units emergency released	4	0	2	8	14
18 # Units Shipped (West L.A VA)					72

One factor contributing to the discrepancy may be the scope of services provided at the MOFH, with lack of cardiac surgery being the most likely culprit behind a lower proportion of transfusions occurring in the operating room. Despite the 75/25 ratio, this research focuses on

potential changes that will have an effect on both medical and surgical services. Where applicable and practical, the analyses provide exposure to the costs and benefits of incorporating blood management across the entire spectrum of care at the MOFH.

Medical Services Policies and Guidelines

While the blood management efforts at the MOFH fall short of being a uniform, comprehensive program, there are several policies in various stages of implementation that form the foundation of the beginnings of one. First, the blood bank has spearheaded a MOFH Instruction (MOFHI 44-16), recently approved by the MOFH commander, that includes a detailed set of guidelines for transfusion trigger screening criteria (Appendix A). Although the instruction was approved in December 2008, the screening criteria have been in place for over three years. MOFHI 44-16 also addresses several other relevant aspects of blood utilization and management, including but not limited to the ordering process (using Standard Form 518), blood product availability, administration protocols, autologous donation procedures, transfusion reaction procedures, and implementation of a transfusion committee. The transfusion triggers that are in place, specifically the red blood cell triggers of Hemoglobin < 8.0 grams per deciliter or Hematocrit < 24%, are moderately restrictive in the context of recent studies and peer reviewed literature.

Surgical Policies and Procedures

Several locally developed instructions address procedures that have the potential to facilitate blood management efforts. Appendix B, MOFHI 44-117, outlines procedures for postoperative autotransfusion of blood. The primary mechanism utilized for this process is the Hemovac Autotransfusion System by Zimmer. The equipment supporting such a process is commonly used in the MOFH during Total Knee Arthroplasty procedures. Another local

instruction developed by the Operating Room Services personnel, details the guidelines for using the Cell Saver device in the perioperative setting. Although the MOFH already owns and maintains one Cell Saver, a review of blood bank records revealed the Cell Saver has not been used more than four times in any of the last three years. As previously mentioned, ANH is not utilized as a blood management technique for any surgical procedure at the MOFH. Erythropoetin therapy, which has major potential in both the surgical and medical services settings, is not consistently utilized by any of the MOFH providers. Consistent with current research, in which transfusion practices can differ greatly by provider and procedure, even those processes that are addressed in formal instructions are implemented inconsistently throughout the MOFH.

Oversight and Intervention

Another initiative in place at the MOFH during the last two years has been an evidence-based review of transfusions. A staff member conducted the reviews in coordination with the blood bank staff and according to the established transfusion guidelines and proper clinical practices. The reviewer documented the results of the assessment on the peer review checklist (Appendix D) and forwarded the peer review sheet for transfusions that did not meet the established guidelines to the MOFH credentialing department. Unfortunately, due to the loss of key personnel and lack of oversight, completion of the reviews ended after the 16-month period between January 2007 and April 2008. The blood bank staff members continue to audit and document those transfusions that occur outside the parameters of the established guidelines, but no peer reviews have been completed since April of 2008.

Table 4 details the instances of transfusions that did not meet the transfusion standards according to the screening guidelines in place during that 16-month timeframe. The table

delineates results of transfusion fallouts by the type of blood product (Red Blood Cells, Platelets, or Fresh Frozen Plasma) and by service. These fallouts became the subject of the peer reviews.

Table 4. Transfusion Fallout Summary, January 2007 – April 2008

Transfusion Fallouts	RBC			PLT			FFP		
by PATIENT	Medical	VA	Surg	Medical	VA	Surg	Medical	VA	Surg
2007 Jan	6					1			
Feb				2					
Mar	2					2	1		1
Apr	2		1	1		1			
May	5		1						
Jun	7			1					
Jul	2			1		1			
Aug	5		2						1
Sep	5		1				2		1
Oct	2			5					2
Nov	11						1		1
Dec	4			1			2		1
2008 Jan	11						1		
Feb	6			1		2	3		
Mar	2					1			1
Apr	3								

For the purposes of Table 4, the group titled "Medical" reflects all medical services, the maternal child department, family practice, and the emergency department. The Surgical Services fallouts represent perioperative transfusions that fell outside of the established guidelines. Simply monitoring violations of the transfusion trigger guidelines would not adequately reflect the appropriateness of transfusions.

The peer review process is a vital element of evaluating appropriateness and developing consistency in the way transfusions are conducted in the facility. Unfortunately, due to changes in staff, a process that was not backed up by policy, and a lack of leadership/committee oversight, evidence-based peer review of transfusion appropriateness has been sporadic and inconsistent at the MOFH. The MOFH Blood Bank staff sent out audit screening sheets for each of the transfusions identified as falling outside the screening criteria. Of the more than 100 audit sheets sent out over the 16-month period, only 20 audits were completed and returned to the blood bank staff. Of the audits completed, none identified a single inappropriate transfusion. These results are inconsistent with the literature from numerous peer reviewed studies and

randomized controlled clinical trials (Bray, T., Salil, P., Weiss, H., & Porter, J., 2003; Rothschild, J., McGurk, S., Honour, M., Lu, L., McClendon, A., Srivastava, P., et al., 2007). The lowest documented rate of inappropriate transfusion identified in recent studies was one that identified inappropriate transfusion rates of 15% for red blood cells. This rate occurred in a multihospital system prior to the implementation and utilization of Six Sigma and change acceleration techniques to reduce unnecessary transfusions (Neri, Mason, and Demko, 2008). The initiatives resulted in a reduction of inappropriate transfusions to 5%. In another study, a randomized controlled clinical trial that included computerized decision support intervention identified a rate of inappropriate transfusions of 72% (Rothschild et al., 2007). The results of the intervention and education efforts in this study resulted in a reduction to 63% of transfusions being inappropriate. The disparity between peer-reviewed, documented inappropriate transfusion rates and the rates identified at the MOFH indicate the local peer reviews, one the rare occasion they were actually completed and turned in, severely under-reported the level of inappropriate transfusions at the MOFH. The potential implications of initiating a comprehensive blood management program that includes formal, recurring administrative and clinical oversight highlights the potential for proper identification of inappropriate transfusions and reduction in the occurrence of inappropriate transfusions. Any efforts at the MOFH to optimize blood management must include consistent clinical review, buy-in from providers in all services, clinical champions, and oversight from an executive level committee to ensure deviations from transfusion standards are based on clinical evidence.

Analysis Framework

The ensuing analysis follows the basic framework for a business case analysis outlined by Schmidt (2002) in the second edition of her *Business Case Guide*. This analysis will establish

several potential courses of action. Based on the available data regarding current blood management programs and on current operations in the MOFH, the two scenarios under consideration are implementing a blood management program that just addresses surgical services and implementing a comprehensive program that also attempts to reduce transfusions in the medical services. These scenarios are compared against maintaining the current status quo. Each potential scenario and course of action will be evaluated independently in the context of the data from the MOFH and civilian programs. Transfusion and blood utilization data from 2006 through 2008 provides the baseline from which projections and extrapolations are made. The baseline data helps determine the viability of potential courses of action. Sources of data for the measurement of baseline data as well as potential outcomes include military specific systems such as the Military Health System Mart (M2), Armed Forces Health Longitudinal Technology Application (AHLTA), and Expense Assignment System (EASIV). M2, as well as the VA's Computerized Patient Record System (CPRS), provided historical workload data for surgeries performed at the MOFH. The Expense Assignment System (EASIV) is the primary source for expense data and it provided the salary expenses detailed in this research.

Scope of the Case

Each potential course of action outlined in these analyses has time, organization, and technology requirements associated with its implementation. The analysis projects costs and potential savings over a period of three years using costs obtained from FY08. Implementation for any scenario would occur starting 1 October 2009 at the latest. Costs and benefits, unless otherwise noted, would begin to be incurred at that time. The exception to this date is equipment purchases, which could occur prior to October 2009.

Surgical Services

Workload – As previously noted, the surgical procedures with the highest historical rates of transfusion generally fall under one of three categories: vascular surgery, cardiac surgery, and orthopedic surgery. These analyses required a determination to be made as to which surgeries in the MOFH would likely have an adequate level of blood loss to facilitate utilization of the surgical techniques discussed in the literature review. The discussion about these procedures included several disciplines and representatives from the Operating Room, including anesthesiology staff, surgical providers, and surgical nurses. These discussions resulted in a list of ten procedures (Table 5) that the researcher evaluated for potential blood management implementation viability.

Table 5. Surgical Procedures Most Likely to Require Transfusion, 2008

		TRICARE	VA
Procedure	Code(s)		
Total Hip Replacement	27132		15
Prostatectomy	55840, 55845, 55866		1
Nephrectomy	50547, 50545, 50230	1	0
Cholecystectomy	47562-47564	126	31
Abdominal Aortic Aneurysm (AAA)	34800-34805, 34825-34832		
Cesarean Section	59618,59620, 58611,59525	19	
Abdominal Perineal Resection	45110		2
aorto-bifemoral prosthesis	34832		
aorto-bifemoral bypass	35540		1
hysterectomy	58210,58285,		2
exploratory laparotomy	49000	6	26
	Totals:	152	78

The codes identified in Table 5 were International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9 CM) codes utilized in the query from the M2 database to calculate the number of procedures completed on TRICARE beneficiaries in calendar year 2008. In addition to the TRICARE beneficiary workload, the CPRS system provided 2008 procedure data

for VA beneficiaries. The results of these two queries identified 230 procedures from 2008. Two of the procedures (Abdominal Aortic Aneurysm and Aorto-bifemoral prosthesis) identified in the deliberation about MOFH procedures with moderate blood loss or higher were not performed at all during 2008. Additionally, the group discussed the inclusion of Total Knee Replacement in this evaluation, but the current procedures in place at the MOFH include the use of an autotransfusion device which limits the need for allogeneic transfusion during Total Knee procedures and reduces the potential transfusion reductions which would result from perioperative blood management techniques; as a result, including this procedure in the analysis would skew the potential impact of blood management in the perioperative setting toward being less impactful.

Further validation of the feasibility of applying blood management techniques to these procedures indicated a very low historical transfusion requirement for laparotomy procedures and cholecystectomies (Usal, H., Nabagiez, J., Sayad, P., & Ferzli, G., 1999). Usal et al. calculated transfusion rates of 0.46% for laparoscopic cholecystectomies and 5.47% in open cholecystectomies. All but two of the transfusions identified by Usal et al. resulted from pre-existing medical conditions such as anemia and end stage renal disease. These findings mitigate the potential benefit of blood management in the intraoperative setting at the MOFH because 157 of the 230, or 68%, of the procedures identified to have potential for transfusion reduction for 2008 were cholecystectomies. On a related note, the research conducted during this validation resulted in two potential blood management initiatives that possess significant potential benefit for the MOFH. First, there may be financial opportunity in reducing or eliminating automatic blood type and screening for cholecystectomy procedures (Usal, H., et al., 1999). Next, there may be potential cost savings in approaching preoperative transfusion of cholecystectomy

patients with sickle cell disease more conservatively from an evidence-based practice standpoint (Vichinsky, E., Haberkern, C., Neumayr, L., Earles, A., Black, D., Koshy, M., et al., 1995). Although these two initiatives are outside the scope of this project, they demonstrate the inherent potential benefit of establishing a blood transfusion or blood management committee at the MOFH to assess financial and clinical benefits of a variety of evidence-based blood management ideas.

A review of evidence-based literature suggests that, of the ten procedures listed in Table 5, prostatectomy, hysterectomy, and total hip replacements are the procedures most capable of benefitting from pre- and peri-operative blood management techniques. These procedures are three of the five that most commonly use autologous donation (Segal, J., Guallar, E., & Powe, N., 2001). Additionally, evidence-based algorithms can provide the means to reduce blood transfusions in total hip replacements with one study indicating a 14% reduction in the transfusion rate for total hip arthroplasty/total knee arthrolasty with no significant difference in outcomes (Pierson, J., Hannon, T., & Earles, D., 2004). Based on the available literature specific to the types of historical surgical workload accomplished at the MOFH, Scenario 1 of this project will analyze costs and benefits of intraoperative blood management in regards to the following procedures: total hip arthroplasty, prostatectomy, and hysterectomy.

Medical Services

Autologous Donation - Initially projected as a potential cost-saving and allogeneic transfusion-reducing initiative, the PAD process may not provide financial benefit in the context of operations at the MOFH. All PAD units for MOFH patients are processed through the existing UBS contract. As a result, there is no reduction in cost for each unit of blood product. Having the donation completed at a UBS location inconveniences the patient and increases the chance for

error and complication. Additionally, the rate of wastage of PAD units at the MOFH is 34% over the past three years (Tables 1-3). There is also evidence to suggest the use of ANH can replace the need for or benefits of PAD, with the added benefit of being more cost-effective (Monk, T., Goodnough, M., Brecher, M., Pulley, D., Colberg, J., Andriole, G., 1997). The resulting recommendation is to eliminate the process of PAD at the MOFH unless the patient is absolutely adamant about completing autologous donation.

Acute Normovolemic Hemodilution – There is consistent documentation regarding the effectiveness of ANH in reducing transfusions in the surgical setting (Goodnough, M., Shander, A., and Spence, R., 2003). In the context of surgical demand at the MOFH, however, the most common procedures have limited, if any, capacity for the implementation of ANH. Those that could integrate the process accounted for less than 20 procedures in 2008, and a simple calculation of the indirect personnel cost, estimated at an hour per procedure, for setting up and administering ANH indicates it is not a cost-effective option for surgical services at the MOFH given the current scope of services.

Ethical Considerations

Due to the high visibility and highly regulated nature of the procedures already in place for blood transfusion, there are minimal ethical concerns with the potential implementation of a blood management program at the MOFH. One potential aspect of treatment that could have ethical implication includes possible changes to the informed consent practices for certain surgical specialties or blood management techniques. Any informed consent practice changes would require the approval of the ethics committee. The positive aspect of a potential change is that increased patient awareness of a potential MOFH blood management program, in both the

medical services and surgical services settings, and as part of the informed consent protocols, is likely to improve patient satisfaction and understanding.

Global Assumptions

Some of the basic assumptions underlying this analysis include:

1. All data related to blood usage will be accurately reported on SF 518 and compiled in MOFH Blood Bank utilization reports.

2. Any implemented scenarios will not affect nor require modification of the facility's FDA license and registration.

3. Proposed courses of action will not require changes to blood collection practices, with the exception of autologous donation.

4. Data related to operative procedures and their impact on demand for blood products represents minimum basic requirements. This is due to an in-progress OR Optimization effort which is expected to increase the capacity for surgical procedures in the MOFH.

5. No facility modifications will be required beyond those already projected and initiated for the Operating Room area.

6. All costs, to include equipment, staffing, and training will be accurately captured.

7. Current workload is captured and reported accurately.

8. No additional staffing will be allocated for the implementation of a blood management program.

9. Any form of blood management program implemented at the MOFH will be spearheaded by a blood management or transfusion committee.

Financial Metrics

Business case analyses have a common set of financial metrics which help leadership determine the benefit of a new endeavor. Potential metrics include net present value (NPV), return on investment (ROI), and payback period. Because there are no direct costs associated with the initiation of a blood management committee, these financial metrics are not utilized, and the primary results reflected in this cost-benefit analysis are cost savings and cost avoidance.

Financial Benefits

There are a number of potential financial benefits associated with a blood management program. Using the measurement tools identified in the literature review, metrics and calculations agreed upon during discussions with the MOFH Core Team, and financial metrics from the previous section, the financial benefits provide decision support. Among the potential financial benefits are cost savings, such as a reduction in surgical costs or decreased costs associated with the acquisition of allogeneic blood products, and cost avoidance, such as a decrease in the costs associated with blood products from non-contract, Department of Defense sources.

Soft Benefits

There are soft benefits associated with each of the scenarios, implementation in a surgical setting and implementation in a medical setting. The soft benefits are a major consideration in the decision regarding the implementation of a blood management program. This is especially relevant in light of the meager financial savings projected in the scope of this analysis. Although the soft benefits are unquantifiable, there are significant advantages to considering the impact of these benefits. Research indicates there are benefits to both patients and staff resulting from the implementation of a blood management program. Some of those benefits include decreased mortality rates (not a soft benefit), an increase in patient education, improved quality of life

resulting from reduced recovery times, creation of a forum for practitioners' education on blood products and alternatives, and an enhanced reputation as a patient-focused organization (Physicians and Nurses for Blood Conservation, 2008).

Costs

This analysis considers direct costs and indirect costs for both the medical and surgical aspects of blood management. At this time, costs are expected to fall into one of three categories: supplies, personnel, and equipment. It is unlikely that any type of facility modification will be required to facilitate implementation of this program.

Supplies - Consistent with the previous discussions, the primary direct cost in this analysis is units of blood. The MOFH receives its blood from two sources, the first of which is a blanket purchase agreement with United Blood Services (UBS), and the second is the Armed Services Whole Blood Processing Laboratory (ASWBPL) at Travis AFB, California. Table 6 outlines the costs per unit for the UBS agreement.

Table 6. Direct Cost for Blood Product, 2009

Blood Component	2008 Service Fee	2009 Service Fee	Overall Service Fee Increase
Red Blood Cell	$ 237.50	$ 247.00	4%
Apheresis, Platelets	$ 602.00	$ 602.00	0%
Fresh Frozen Plasma	$ 80.00	$ 80.00	0%
Pooled, Cryoprecipitated AHF Equivalent	$ 450.00	$ 500.00	11%
Cryopoor Plasma	$ 95.00	$ 95.00	0%
		Total Overall	2.69%

Also indicated in Table 6 is the increase in blood product costs from 2008 to 2009. Red blood cells, which have the highest utilization at the MOFH, realized a 4% increase in cost year-to-year. The increase in cryoprecipitate cost, while high at 11%, has a negligible impact on the facility because the MOFH has used only six units in the last two years combined. The "Total Overall" rate reflects the collective total percentage increase in the price of blood products.

While there is no direct cost to the facility for ASWBPL blood units, every unit saved represents a cost avoidance to the MOFH and to the Department of Defense as a whole. Communication with the three Air Force Donor Centers, indicated the per-donor unit cost for packed red blood cells, which includes collection materials and testing costs, equated to $90.62. This total does not include the associated facilities or personnel costs which were not calculated by the donor centers, the ASWBPL, or the Air Force Medical Operations Agency (AFMOA). Coupled with the discounted transportation rate provided by a commercial carrier, the per-unit cost calculated by the MOFH blood bank staff for ASWBPL units is $110 for packed red blood cells. The cost avoidance for ASWBPL blood products has the secondary benefit of making blood units at the donor centers available for use at another facility. Historical usage rates from for UBS and ASWBPL blood indicate that an average of 84% of red blood cells utilized at the MOFH come from UBS (Appendix E). There has been a shift, however, resulting from an increased focus in the MOFH on utilizing ASWBPL products, and in 2008 the proportion of ASWBPL units used in the facility was close to 60%.

In addition to the direct costs associated with blood from UBS and the inherent costs of blood products from the ASWBPL, there are indirect costs associated with transfusion of blood products in the MOFH. Transfused units go through vigorous testing, including but not limited to type and screen, type and cross, antibody testing, and various other tests to ensure the safety of

the product. The medical technologist time associated with these testing procedures is an expense associated with the true cost of the blood product. Blood bank team members at the MOFH spend an average of 50 minutes per unit processing the proper tests prior to transfusion. The associated personnel expense for this effort, pulled from the EASIV database and rounded to one full hour of technologist time per unit, is $27.93 (Appendix F). In addition to the testing done at the MOFH, there is a portion of blood products that must be sent to UBS for additional test. The return and additional testing of blood products requires additional processing, handling, and fees which are spelled out in the UBS contract. Workload estimates from the first three months of 2009 indicate returns occur for about 10% of the blood products tested at the MOFH. The contract-specified cost of the additional testing, $688.45, annualized over the course of a year, and divided by units utilized represents an additional marginal cost per unit of $13.92. Finally, there is also personnel expense associated with the actual administration of the blood product. The process of administering the product requires a significant time commitment from the nurse responsible for the transfusion. The assumption is that for a specified amount of time, in this case one hour, the nurse's complete attention would be devoted to administering the blood and monitoring the blood product recipient. Although the time can vary based on the setting, type of patient, and the procedure, this research utilizes an average of one hour of dedicated time per unit transfused based on discussions with clinical and surgical staff members. Appendix F indicates this average hourly expense to be $48.42. Table 7 details the consolidation of direct and indirect costs to calculate the true cost of both UBS and ASWBPL blood products for the MOFH.

Table 7. Calculation of Blood Product True Costs

2009

	RBC	Platelets	FFP	ASWBPL
Direct	$ 247.00	$ 602.00	$ 80.00	$ 110.00
Additional testing (Marginal Cost)	$ 13.92	$ 13.92	$ 13.92	
Indirect				
Avg personnel expense (Tech)	$ 27.93	$ 27.93	$ 27.93	$ 27.93
Avg personnel expense (Nurse)	$ 48.42	$ 48.42	$ 48.42	$ 48.42
True cost of blood Product	$ 337.27	$ 692.27	$ 170.27	186.35

Business Impacts

The primary consideration for Scenario 1, implementation of blood management in the surgical setting, was to determine costs versus potential savings based on the expected blood transfusion demand from the three selected procedures. A review of blood bank records indicated that the average transfusion requirement for Total Hip Replacement at the MOFH is well below one unit per patient. The one prostatectomy in 2008 required an exorbitant amount of blood products due to complications, so the calculations for this scenario incorporate a historical requirement of seven units per patient from the previously identified article by Monk (2007). Hysterectomies at the MOFH have a historical blood usage of one half unit per patient. These numbers provide the baseline costs. Because the requirements are so low for these procedures, even a complete elimination of transfusions for the selected procedures would result in savings of less than $2500 (Table 8). Even if the half-unit usage were rounded up to one full unit per patient, cost savings would be minimal in relation to the required personnel expense. Any of the techniques outlined in this research, whether it is Cell Savers, ANH, or pharmacological

approaches, would be cost prohibitive unless the goal is to achieve potential reductions in infection or complication. Although peer-reviewed studies have indicated these are potential benefits to reduced transfusions, they have had difficulty defining and quantifying the associated costs, essentially turning the positive impacts into "soft" benefits. Table 8 summarizes the costs and savings associated with surgical services in the MOFH. The total for knee replacements are include for informational purposes, since further reductions in transfusion are unlikely based on the techniques outlined here. In addition, the hysterectomy procedures were shown to have transfused no units during this three month span. Table 3 provided the basis for selection of the procedures, but to evaluate the most recent efforts in the MOFH, laboratory staff put together transfusion data from March – May of 2009. Table 8 reflects documented procedures and transfusions projected out to reflect annualized expectations.

Table 8. Cost Savings Analysis, Scenario 1

Scenario 1								
	Procedure	# Procedures/year (actual*4)	Avg Blood Req/Proc	Total Requirement	Projected Reduction in Reqt Using Blood Mgmt Techniques	Calculated Cost per (RBC) Unit Direct/Indirect Costs	Total Cost	
	Total Hip Replacement	40	1.1	44	0.375	$ 350.00	$	131.25
	Total Knee Arthroplasty	88	0.55	48	0	$ 350.00	$	-
	Prostatectomy	1	7	7	2	$ 350.00	$	700.00
	Hysterectomy	60	0	0	0	$ 350.00	$	-
						Total Cost of Blood Rquirements	$	831.25
Implementation Costs		Equipment Cost	Supplies	Personnel (1 hour OR time x # procedures)				
	ANH	NA	NA	774.72				
	Celi Saver	NA	NA	774.72				
	Patient Autologous Donation	No longer recommended for use at MOFH						

Due to the limited scope of services and workload for procedures that have the capacity for utilizing blood management techniques, cost savings in the surgical setting is unlikely and implementation of these techniques as part of a blood program would be based on the potential

soft benefits such as reduced infection, reduced surgical complications, lower blood product wastage rates, and fewer transfusion reactions.

The final element of cost savings calculated in Scenario 1 is a result of the proposed elimination of PAD from use at the MOFH. The wastage rate for this blood product is 34% over the last three years, and since the product still comes through UBS, there is no inherent cost advantage to continuing to utilize this element of blood management. In addition, there is increasing support for the ability of other blood management techniques to replace any quantifiable benefit of PAD including blood salvage, pharmacotherapy, and reduced transfusion triggers (Goodnough and Shander, 2007). The elimination of PAD, as outlined in Table 9, has the potential to save $4,929.56 over the next three years.

Table 9. Cost Savings from Elimination of Patient Autologous Donation

Elimination of PAD units		Usage	Wastage				
	2006	20	5				
	2007	17	10				
	2008	10	1				
							Average Waste
	Total	47	16				34%
	PROJECTIONS		Average Waste		Projected Waste	Cost Per Unit**	Cost Savings
	2009	16	34%		5	$ 323.35	$1,722.38
	2010	14	34%		5	$ 336.28	$1,626.12
	2011	13	34%		5	$ 349.74	$1,581.06
						Total Savings 2009-2011	$4,929.56

Scenario 2 reflects an approach to facilitate cost savings by eliminating allogeneic transfusions in the medical setting. Several assumptions had to be made regarding this scenario in the absence of a formal program for blood utilization, any type of peer review process, and limited ability to dissect the data. The first major assumption involved the expected level of inappropriate transfusions currently taking place in the MOFH and the corresponding level of

projected transfusion reductions based on implementation of blood management program. The researcher attempted to utilize the most conservative estimates for transfusion defects prior to and after implementation of blood management techniques. A 2008 study by Neri et al. identified an initial level of transfusion defects of 16% for red blood cells and 6% for platelets and fresh frozen plasma. During the course of implementation of a program that focused completely on process management techniques, such as Six Sigma and the Change Acceleration Program, the defect rates were reduced to 5% and 3% respectively (Neri et al., 2008). The rates are consistent with the results of a random sample of more than the 1000 units over the course of an 18-month period at the MOFH, during which over 22% of the red blood cells were transfused outside the stated hemoglobin and hematocrit parameters. These initial defect and defect reduction rates were far more conservative than 30% to 70% range found in other literature (Paxton, 2008; Rothschild et. Al, 2007; Goodnough and Shander, 2003). To make the estimates even more conservative, the calculated defect reduction rate for red bloods cells utilized for this study was 8%, or half of the overall inappropriate rate, rather than 5% as was outlined in the Neri (2008) article. The use of the more conservative defect reduction rate was an effort by the researcher to account for the challenges of implementing a new, extremely strict evidence-based process improvement.

The other assumptions in the study involved the projected allocation of UBS blood product and ASWBPL blood product. The significant increase, from 16% to 60%, in the use of ASWBPL blood is expected to wane slightly until further evaluation can be done regarding the recent increase in transfusion reactions and its correlation to the increased use of ASWBPL blood. The result is a projected 50/50 balance between UBS and ASWBPL blood for the duration of these projections. Cost projections utilized the 50/50 ratio for the blood product

procurement source to provide a more conservative, and likely more accurate, depiction of the allocation of blood product utilization. It is important to note that only red blood cell calculations are affected by the UBS and ASWBPL allocation. Cost increases over the course of the following three years were based on recent increases in blood product rates in the UBS contract, which stood at 4% for red blood cells and 11% for fresh frozen plasma.

Appendix H summarizes the result of cost savings calculations based on the assumptions outlined above, the MOFH's historical blood utilization, workload projections based on moving averages, and true blood product costs. Simply by initiating consistent, evidence-based oversight and peer review and using the results of that process to educate staff at all levels, the MOFH could expect potential savings of $42,955.16, $35,937.03, and $36,684.00 in 2009, 2010, and 2011 respectively. These numbers also do not reflect the unquantifiable soft benefits (reduced risk of infection, patient satisfaction, etc.) outlined in the prevailing literature.

Sensitivities, Risks, and Contingencies

Sensitivities and Limitations

There are a number of sensitivities associated with and evaluated during the course of this analysis. Currently, the considerations include potential changes to workload and demand estimates. Projections of future workload must utilize accurate data, so close attention will be paid to validating the accuracy of baseline workload and demand data. These areas can have considerable impact on the projected costs, savings, and cost avoidance, and will be carefully developed, monitored, and evaluated to ensure accuracy. Baseline data for transfusions is accurate from a summary standpoint, but the limitations of collecting and organizing the data without an electronic medical record or management information system inhibited the ability of the researcher to analyze transfusion data in a more detailed manner. Additionally, it is difficult

to discern which transfusions classified under surgical services were completed intraoperatively. As a result, projected cost savings may be underrepresented in this report due to the fact that oversight and peer review may facilitate potentially unaccounted for allogeneic transfusion reductions in the pre- and postoperative settings as a carryover effect of the initiation of a blood management committee.

During the course of this analysis, a number of factors regarding demand for surgical services became apparent. First, the most significant factor in terms of surgical demand and the need for allogeneic transfusions is the service mix in the MOFH Operating Room. Much of the literature involving perioperative techniques to reduce allogeneic transfusions involves three categories, cardiac surgery, orthopedic surgery, and vascular surgery. Of the three most commonly evaluated services, the MOFH provides orthopedic surgery and an extremely limited amount of vascular surgery. Another factor adding to the inability to project potential savings accurately is the potential growth and/or reduction of services in the MOFH following the completion of a new Veteran's Affairs hospital. At the time of this research, it is unclear whether the scope of services available to MOFH beneficiaries will increase in a substantial way, remain consistent, or decrease. Leadership is working diligently to establish collaborative agreements with the VA, but the net effect on demand for services, especially in the surgical setting, is unclear.

One sensitivity not directly associated with workload, but that could impact projected reductions in the use of allogeneic transfusions is the knowledge and skill of the staff members in using Cell Savers or autotransfusion devices (The Joint Commission, 2007). The impact of skill differentiation could affect the cumulative numbers of allogeneic units required, especially in the orthopedic surgery setting. The MOFH has established policies and guidance for the use of the

Cell Saver and the reinfusion devices currently in use in the facility; however, leadership must continue to provide consistent, recurring training to ensure staff members remain proficient at using the devices. This is especially important due to the sporadic need for the devices based on the types of procedures completed at the MOFH. A blood management committee could serve to facilitate this type of recurring education.

Risks and Contingencies

Currently several risks are of concern regarding the implementation of a blood management program at the MOFH. First and foremost is the ability to train staff to adapt to a blood management program. A prevailing theme in the majority of literature regarding implementation of blood management and blood conservation is the need for effective education. Next, there is a concern over the ability to obtain buy-in from clinical staff, administrative staff, and leadership regarding a wholesale change to medical and surgical operations. The strict enforcement of transfusion triggers and any changes to procedures in the surgical department are likely to be contentious if buy-in is not facilitated in advance of implementation. Experts and those with experience implementing blood management programs state the ability of a clinical champion to educate colleagues, motivate peers, and lead change cannot be understated (Paxton, 20008; Neri, Mason, and Demko, 2008). The presence of a champion becomes even more valuable if leadership decides to make transfusion triggers even more restrictive. Another factor of concern is whether the implementation will result in improved outcomes. Evidence suggests outcomes are as good or better, but never worse, utilizing restrictive transfusion triggers and blood management techniques; however, there must be strong oversight, buy-in from the staff, and adequate training (American Red Cross, 2007; Rothschild et al., 2007).

An initial search indicates that one Las Vegas area hospital has instituted a comprehensive blood management with bloodless surgery techniques (Society for the Advancement of Blood Management, 2008). In addition, the author participated in a massive performance improvement initiative which included three local hospitals that are part of Healthcare Corporation of America (HCA) network. During the course of this project, the HCA facilities evaluated and implemented several blood utilization and management initiatives, with cost savings for the respective facilities projected in the hundreds of thousands of dollars annually. From a contingency standpoint, it is possible to collaborate with existing local programs to gain synergies or capitalize on lessons learned through their efforts at implementing some of the techniques and processes outlined in this research.

Recommendations and Conclusion

Given the potential cost savings associated with the reduction of inappropriate transfusions, and the soft benefits associated with reducing allogeneic transfusions in the surgical setting, the recommendation based on this research is to implement Scenario 2 through the initiation of a blood management committee. This committee should be the focal point of managing the transfusion of all types of blood products at the MOFH. There are a number of factors that suggest the process will be less challenging than if it were to be started completely from scratch. First, the newly signed MOFH Instruction recommends implementation of a transfusion committee. Additionally, the blood bank staff already proactively audits all transfusions that occur at the MOFH, maintains records and metrics on the distribution of UBS and ASWBPL blood, and identifies for peer review those transfusions that do not meet established guidelines. Data collection and associated metrics are a crucial element of the oversight required to implement the evidence-based approach necessary to garner cost savings

from reduced allogeneic transfusions. Arguably the most important element of the function of the blood committee is its ability to educate providers, as well as support staff, concerning the most current and effective evidence-based practices regarding transfusion. The inclusion of clinical champions, as previously stated, is vital to the effort, as those individuals provide invaluable influence on the people most capable of enacting change.

Although the scenario of blood management in the surgical setting at the MOFH projected little to no cost savings, the potential for reduced infection and complication stemming from intraoperative processes such as ANH and autotransfusion and preoperative therapies such as epoetin alfa and iron therapy merits further in-depth prospective evaluation under the watchful eye of a blood management committee. The potential benefits become even greater if the scope of surgical procedures expands into vascular or cardiac surgeries.

In addition to the initiatives outlined in this analysis, numerous other opportunities exist to more effectively manage blood products at the MOFH, eliminate allogeneic transfusions, or provide cost savings to the organization. The opportunities, some of which have been mentioned during this research, could have considerable impact on operations at the MOFH. They include but are not limited to, the elimination of Type and Screen testing for procedures that are highly unlikely to require transfusion, and the reduction of transfusion triggers for red blood cells to a threshold of as low as 7 grams per deciliter without any adverse effect on outcomes (Guzick, 2008). The potential reduction of transfusion reactions through a more balanced distribution of UBS and ASWBPL blood products is another possible area of concern for the blood management committee.

All of the possible benefits of blood management start with one thing, a governing body committed to evidence-based evaluation and management of the processes, procedures, and

policies at the MOFH. There is no step more important in these processes than establishing and maintaining a strong blood management committee made up of leadership, clinical and support champions, and key stakeholders. With the right team members on the committee, potential cost savings and other benefits will outshine the conservative estimates in this analysis. The committee would also be the breeding ground for future research and implementation efforts that would even further enhance the safety and financial viability of blood management techniques. The recommendation to MOFH leadership is to establish the committee as soon as possible and enable it to serve as the focal point for implementation of the second scenario, implementation of change to transfusion practices in the medical services departments. Although Scenario One did not establish as strong a case for implementation in the perioperative setting, the committee should reevaluate opportunities in the surgical departments as services expand and capabilities develop in the coming years. As the MOFH continues to grow, so does the opportunity to capitalize on blood management techniques to enhance the safety of our patients under the watchful eye of an effective blood management committee.

References

99th Medical Group. (2007). *The Mike O'Callaghan Federal Hospital: August 2007.* Nellis AFB, NV.

Air Force Medical Operations Agency. (2008). Proof report: 99th Medical Group.

American Red Cross. (2007). Practice guidelines for blood transfusion: Second edition. Retrieved 9 April, 2008 from http://www.redcross.org/www-files/Documents/WorkingWiththeRedCross/practiceguidelinesforbloodtrans.pdf

Bennett, J., Haynes, S., Torella, F., Grainger, H., & McCollum, C. (2006, July). Acute normovolemic hemodilution in moderate blood loss surgery: a randomized controlled trial. Transfusion, 46(7), 1097-1103.

Bray, T., Salil, P., Weiss, H., & Porter, J. (2003, February). Transfusion medicine in India: A survey of current practice. *Transfusion Medicine*, 13(1), 17-24.

Casati., V., Benussi, Sandrelli, L., Grasso, M., Spagnolo, S. & D'Angelo, A. (2004, May). Intraoperative moderate acute normovolemic hemodilution associated with a comprehensive blood-sparing protocol in off-pump coronary surgery. *Anesthesia And Analgesia*, 98(5), 1217. Retrieved January 15, 2009, from MEDLINE database.

Crum, E. (2007). Can a bloodless surgery program work in the trauma setting? Nursing 2007. 37(3), 54-56.

Goodnough, L., Shander, A., Spence, R. (2003, May). Bloodless medicine: clinical care without allogeneic blood transfusion. *Transfusion*, 43(5), 668-676.

Guzick, D., (2008). Saving blood, saving money, saving lives. University of Rochester, School of Medicine and Dentistry. Retrieved December 30, 2008 from http://www.urmc.rochester.edu/smd/newsletter/article.cfm?id=138

Hebert, P., Wells, G., Blajchman, M., Marshall, J., Martin, C., Pagliarello, G. et al. (1999, February). A multicenter, randomized, controlled clinical trial of transfusion requirements in critical care. Transfusion Requirements in Critical Care Investigators, Canadian Critical Care Trials Group. *The New England Journal Of Medicine*, 340(6), 409-417

Jaspan, D. (2007). Erythropoietic therapy: Cost efficiency and reimbursement. American Journal of Health-System Pharmacists. 64(Supp 11), 519-529.

Koch, C., Li, L., Sessler, D., Figueroa, P., Hoeltge, G., Mihaljevic T, Blackstone, E. (2008). Duration of red-cell storage and complications after cardiac surgery. *New England Journal of Medicine*. 358(12), 1229-1239

Matot, I., Scheinen, O., Jurim, O., Eid, A. (2002, October). Effectiveness of acute normovolemic hemodilution to minimize allogeneic blood transfusion in major liver resections. Anesthesiology, 97(4), 794-800. Retrieved January 15, 2009, from MEDLINE database

Monk, T., Goodnough, M., Brecher, M., Pulley, D., Colberg, J., Andriole, G. (1997, November). Acute normovolemic hemodilution can replace preoperative autologous blood donation as a standard of care for autologous blood procurement in radical prostatectomy. *Anesthesia And Analgesia*, 85(5), 953-958.

McCarthy, M. (1999, October). Bloodless surgery: ultrasound cleans up operations. The Lancet. 352, 1450.

Neri, R., Mason, C., & Demko, J. (2008, May). Application of six sigma/CAP methodology: Controlling blood- product utilization and costs. *Journal of Healthcare Management*, 53(3), 183-196.

Nichols, M. (2000, July 24). 'Bloodless' surgery. *Maclean's*, 113(30), 40. Retrieved

May 11, 2008, from Academic Search Complete database.

Northeast Baptist Hospital. (2008). Bloodless medicine and blood conservation newsletter. 1(1), 1-4.

Paxton, A. (2008). Soon, all eyes on better blood use. *College of American PathologistsToday.* Retrieved January 5, 2009 from http://www.cap.org/apps/cap.portal?_nfpb=true&cntvwrPtlt_actionOverride=%2Fportlets%2FcontentViewer%2Fshow&_windowLabel=cntvwrPtlt&cntvwrPtlt%7BactionForm.contentReference%7D=cap_today%2F1208%2F1208_soon_all_eyes_03.html&_state=maximized&_pageLabel=cntvwr

Physicians and Nurses for Blood Conservation. (2008). *Educational resources: Benefits.* Retrieved 2 June, 2008 from http://www.pnbc.ca/06_01_04.en.html.

Ratcliffe, C. (2004). Development and implementation of a bloodless medicine and surgery program. Journal of Healthcare Management. 49(6), 405-409.

Rosenblum, N., Levine, M., Handler, T. etal. (2000). The role of preoperative epoetin alfa in men undergoing radical retropubic prostatectomy. *Journal of Urology.* 163, 829-833.

Rothenberg, R., Barrett, W. (1998, February). `Bloodless' operations eliminate transfusions. USA Today Magazine, 126(2633).

Rothschild, J., McGurk, S., Honour, M., Lu, L., McClendon, A., Srivastava, P., et al. (2007, February). Assessment of education and computerized decision support interventions for improving transfusion practice. *Transfusion*, 47(2), 228-239.

Sample, I. (2008). Many blood transfusions may increase risks, doctors warn. *The Guardian* April 24, 2008. p12 Retrieved 24 May 2008 from http://www.guardian.co.uk/science/2008/apr/24/medicalresearch.health.

Schmidt, M. J. (2002). The Business Case Guide (2nd ed.). Boston: Solution Matrix Ltd

Seeber, P., Shander, A. (2007). Basics of blood management. Malden, Massachusetts. Blackwell Publishing.

Segal, J., Guallar, E., & Powe, N. (2001, December). Autologous blood transfusion in the United States: clinical and nonclinical determinants of use. *Transfusio*n, 41(12), 1539-1547.

Segal J., Blasco-Colmenares, E., Norris E., Guallar, E. (2004). Preoperative acute normovolemic hemodilution: a meta-analysis. Transfusion, 44(5), 632-644.

Society for the Advancement of Blood Management. (2008). Public and Patients. Retrieved June 2, 2008 from http://www.sabm.org/public/

Shinkman, R. (1998). More going bloodless. *Modern Healthcare*. 28(45), 57-58.

The Joint Commission. (2007, January). A new look at blood transfusion. *Joint Commission Perspectives on Patient Safety*. 7(1), 7-8.

Theusinger, O., Leyvraz, P., Schanz, U., Seifert, B., Spahn, D. (2007). Treatment of iron deficiency anemia in orthopedic surgery with intravenous iron: Efficacy and limits: a prospective study. Anesthesiology, 107(6), 823-927.

Usal, H., Nabagiez, J., Sayad, P., & Ferzli, G. (1999, February). Cost effectiveness of routine type and screen testing before laparoscopic cholecystectomy. *Surgical Endoscopy*, 13(2), 146-147.

Vichinsky, E., Haberkern, C., Neumayr, L., Earles, A., Black, D., Koshy, M., et al. (1995, July). A Comparison of conservative and aggressive transfusion regimens in the perioperative management of sickle cell disease. *New England Journal of Medicine*, 333(4), 206-214.

Waters, J. (2004, December). Overview of blood conservation. *Transfusion*. 44 (Supplement), 1-3.

Appendix A – Transfusion Trigger Screening Criteria, MOFH

Screening Audit Criteria for Blood Utilization
99th Med Group/Mike O'Callaghan Federal Hospital

Audit criteria for justification of transfusions of: **Cryoprecipitate** as approved by the Medical Staff.

1. Hemophilia A
2. vonWillebrand's Disease
3. Bleeding and fibrinogen <100 mg/dL
4. Factor XIII deficiency

Audit criteria for justification of transfusions of: **Platelets** as approved by the Medical Staff.

1. < 50 K/ul and impending surgery or invasive procedure
2. <20 K/ul platelet count nonbleeding patient
3. > 12 min bleeding time, abnormal platelet aggregation studies, prophylaxis for patient on drug likely to cause platelet dysfunction
4. > 10 units PRBCs transfused in < 24 hours

Audit criteria for justification of transfusions of: **Fresh Frozen Plasma** as approved by the Medical Staff.

1. Clotting factor deficiency replacement
2. PT >21.6, PTT >54.9
3. Emergency reversal of warfarin, treatment for TTP or coagulopathy related to severe liver disease.
4. >10 units PRBC's transfused in <24 hours and bleeding

Audit criteria for justification of transfusions of: **Packed RBCs** as approved by the Medical Staff.

1. ≤8 gm Hgb/dL (Hct 24%)
2. <9 gm Hgb/dL (Hct 27%) for surgical patients
3. >2 gm Hgb/dL drop in <24 hours
4. <10 gm Hgb/dL (Hct 30%) if Autologous Units
5. Intra-Operative Blood Loss of >500cc or Unstable Vital Signs

Appendix B – MOFH Instruction on Postoperative Autotransfusion

OPERATING INSTRUCTION FOR POSTOPERATIVE AUTOTRANSFUSION

PURPOSE: This operating instruction (OI) outlines guidelines and responsibilities to ensure appropriately trained personnel are assigned to provide patient care. It supplements Air Force (AF), medical group and squadron guidelines. This OI applies to all Mike O'Callaghan Federal Hospital (MOFH) medical personnel involved in the direct care of patients admitted to the MOFH.

SCOPE: This operating instruction applies to all MOFH personnel who work with postoperative auto transfusion.

SUMMARY OF REVISIONS: This is the initial publication of MOFHI 44-117 and must be completely reviewed.

REFERENCES:

1. Standards for Blood Banks and Transfusion Services, 25th edition, Standards Committee American Association of Blood Banks.

2. Hemovac Autotransfusion System Instruction Manual, Zimmer, Inc., Zimmer Orthopaedic Surgical Products, Revised 2004.

1. GENERAL INFORMATION:

An autotransfusion device is used for the collection and reinfusion of the patient's own blood following certain surgical procedures. Collection/reinfusion of salvaged blood is for autotransfusion purposes ONLY; it is not given to any other patient. Follow Standard Precautions throughout procedure.

2. EQUIPMENT:

2.1. Autotransfusion system.
2.2. Blood administration tubing with microaggregate blood filter and intravenous (IV) fluids.

2.3. Supplies for Standard Precautions and aseptic technique.
2.4. Autotransfusion replacement system/bag (if more than one autotransfusion is ordered/anticipated).

3. PROCEDURE:

3.1. Operating Room Set Up Procedure:

3.1.1. The autotransfusion system is initially set up in the operating room using sterile technique in accordance with manufacturers recommendations.

3.1.2. Place a label with patient's first and last name, register number, start time and date, and expiration time and date on the collection bottle. The statement, "For Autologus Use Only", must appear on the collection bottle. Document time collection is started on AF Form 1864, Perioperative Nursing Record.

3.2. Blood Collection:

3.2.1. The Hemovac Evacuator will expand during blood collection. When the evacuator has expanded to the halfway point, uncap the spout, compress the evacuator several times, and recap the spout.

3.2.2. Check the Hemovac periodically to ensure system is deflated and suction is maintained. Check all system clamps to ensure they are open when system is in use.

3.2.3. When collection bottle is full, or when the ordered amount has been collected, initiate reinfusion. To alleviate any confusion regarding collection bottle, always keep the bottle at the patient's bedside when changing out collection bottles.

3.3. Reinfusion:

3.3.1. Blood transfusion must be started within four hours of collection (BLOOD IS NOT TO BE STORED).

3.3.2. Blood reinfusion should be completed within 6 hours of initiating collection.

3.3.3. Using aseptic technique, clamp off wound drainage system and disconnect collection bottle for reinfusion.

3.3.4. Prepare a standard transfusion tubing set with a microaggregate (20 or 40 micron) filter.

3.3.5. Verify patient identification and the physician order for reinfusion with another nurse or technician. Document verifying individual on AF Form 3069, Medication Administration Record. Inspect bottle for obvious clots and discoloration. If there are clots or discoloration, discard the container and attach the tubing to a new collection container. Obtain baseline vital signs and document on Vital Sign Flow Sheet. Continue to monitor vital signs q 15 min X 3, then q 1 hour for the duration of the transfusion. Record time transfusion starts and ends including names of persons starting and ending transfusion, on AF Form 3069. Intensive Care Unit will use AF Form 3909, Critical Care Flowsheet, to document autotransfusions. Post Anesthesia Care Unit (PACU) will use MOFH 0-65, Post Anesthesia Care Unit Record, to document autotransfusions.

3.3.6. When completed, discard collection bottle in biohazardous waste. Collection bottles are NOT sent to the lab.

3.3.7. Utilize a second blood collection/reinfusion bottle per physician order. Place a label with the patient's first and last name, register number, start time and date, and expiration time and date. The statement, "For Autologus Use Only", must appear on the collection bottle. If less than 450ml were collected during the first four hours the drain is commonly ordered to be connected as a wound drainage device without reinfusion capability.

3.3.8. Once the system is re-activated ensure all clamps are open and the hemovac is deflated.

3.4. Treatment of Adverse Reactions:

3.4.1. Adverse reactions are rare for patients receiving autotransfusions. All patients are watched closely for the following: urticaria, laryngeal edema, chills, elevated temperature, hematuria, shortness of breath, or lung congestion.

3.4.2. If an adverse reaction is suspected, discontinue the blood transfusion immediately, call the physician, change the blood tubing and maintain a patent IV. Obtain lab tests as ordered by the physician.

4.0. QUALITY CONTROL:

4.1. Autotransfusion is contraindicated if malignant lesions are present in the area of blood accumulation; gross contamination of the patient's blood by sepsis; and if a fluid unsuitable for intravenous infusion is present in the collected blood (i.e. hemostatic agents, betadine or iodine). Autotransfusion is also contraindicated for patients with existing coagulopathies and impaired renal function.

4.2. Autotransfusion blood is NOT to be warmed in a blood warmer.

4.3. Anticoagulants and other solutions are NOT added to the autotransfusion system at any time.

4.4. Documentation on AF Form 2519, "Overprint American Association of Blood Banks (AABB) Quality Control Criteria for Hemovac Autotransfusion", is used to monitor 100% of all autotransfusions done. This form is collected and reviewed by the Chief of Pathology Services.

Appendix C – MOFH Surgical Department Instruction on Use of Cell Saver

DEPARTMENT OF THE AIR FORCE **SGOSB Operating**
Instruction 44-25
DEPARTMENT OF VETERANS AFFAIRS
99th Medical Operations Squadron (ACC)
Operating Room Services
11 April 2005
Nellis Air Force Base, NV 89191

Operating Room Services

CELL SAVER

This instruction establishes guidelines for the use of the cell saver unit for urgent and emergent cases. It also delineates guidelines for the set-up of the cell saver/autotransfusion unit.

1. **REFERENCE:**

1.1 Haemonetics Cell Saver 5 Autologous Blood Recovery System, Haemonetics Corporation, Braintree, MA 2004

2. **RESPONSIBILITY:** All trained operating room nurses with current documented competency.

2.1 During normal duty hours, a cell saver nurse will be designated for the set-up and operation of the
Cell Saver/autotransfusion. After normal duty hours, the cell saver will not be available.

2.2 **The cell saver/autotransfusion operator is solely responsible for perioperative autologous procedures and shall not perform in any other capacity during the procedure.**

3. **PROCEDURE:**

3.1 The attending surgeon is responsible for ordering the use of Cell Saver for perioperative autologous blood recovery and reinfusion.

3.2 The nurse will obtain the Cell Saver unit from the equipment room (by the cysto room) and take it to the operating room.

3.3 The nurse will assemble all needed supplies and medication prior to autotransfusion set-up. Inspect the cell saving machine for mechanical defects. All factory packaging should be intact and within expiration date for sterile items.

3.4 The nurse will prepare and set-up the unit according to the manufacturer's instruction.

3.5 Once the Cell Saver is set-up, the blood can be collected at the surgeon's direction. If at any time during set-up the nurse has questions or problems, call the manufacturer's support line at (1-800-537-2802).

3.6 The attending surgeon and anesthesia provider will decide whether or not to process the blood collected if there is less than 800cc for re-infusion.

4. **DOCUMENTATION:**

4.1 Prior to transporting the patient to the O.R, the circulating nurse will verify patient identification by using established procedure, ie., asking the patient to state his/her name and social security number, the patient wrist's band, the patient's medical record, and the identification card.

4.2 The circulating nurse will stamp or legibly hand print the patient's name and social security number on Cell Saver labels.

4.3 The label will accompany the patient into the operating room with other imprinted adhesive labels bearing the patient identification.

4.4 Both the circulating nurse and the cell saver nurse will verify the patient's identification prior to attaching the labels on the re-infusion bag.

4.5 A **"For Autologous Use Only"** label will also be placed on the bag. If the blood is known to contain infectious agents a standard biohazard label will also be placed on the bag.

4.6 If the Cell Saver is used during the surgical procedure, the label will be placed on the salvaged blood bag by the Cell Saver nurse. The nurse will state the time and date blood is released for re-infusion and sign his/her initials. See attachment.

4.7 The blood will be given to the anesthesia provider for administration; the anesthesiologist will sign his/her name on the label to verify patient identification prior to re-infusion.

4.8 After the re-infusion process is completed, a copy of the autotransfusion note (see attachment) is placed in the patient's medical record, and a copy sent to the blood bank unit.

5. **PRECAUTIONS:**

5.1 Infusion must be completed within four (4) hours of starting the administration of the blood.

5.2 At no time may the blood be separated from the patient outside the operating room. Blood may leave the operating room **only** if it is being administered at the time the patient is escorted to ICU/PACU.

6. **DISASSEMBLY:**

6.1 Once the surgeon has given his/her OK and the procedure is finished, the equipment may be dismantled. Always wear PPE when handling the cell saver.

6.2 Remove effluent line to waste bag and discard contents according to MOFH 44-5 Infection Control Procedures.

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Operating Room Services Element Chief

JOHN MARTINEZ, MD
Chief, Surgical Care Line

BONNIE MACK, Lt Col, USAF, NC
Col, USAF, MC
Chief, Anesthesia Element
Services

PAUL JOHNSON, Lt

MOFH Chief, Surgical

Appendix D – Peer Review Checklist

99th Med Grp/Mike O'Callaghan Federal Hospital

Screening Audit Criteria For Blood Utilization

Month: Dec Year: 2007

Audit criteria for justification of transfusions of: **Packed RBCs** as approved by the Medical Staff.

1. ≤8 gm Hgb/dL (Hct 24%)
2. <9 gm Hgb/dL (Hct 27%) for surgical patients
3. >2 gm Hgb/dL drop in <24 hours.
4. <10 gm Hgb/dL (Hct 30%) if Autologous Units
5. Intra-Operative Blood Loss of >500cc or Unstable Vital Signs

Patient: Provider:

Reg. #: Service: Med Surgical

AF VA OB Fam. Prac. /ER

Unit(s)	Date /Time Transfused	Pretransfusion Hgb/Hct

Post Transfusion Hgb/Hct:

Audit Criteria Met: Y / N

Post Transfusion Complications: NONE Hemolytic Nonhemolytic

Further Actions:

Refer to M/C Council Refer to Surg Council Refer to Med Council Refer to ER/Fam Council

Auditor: Kenneth S. Sayer, SSgt, USAF Date:

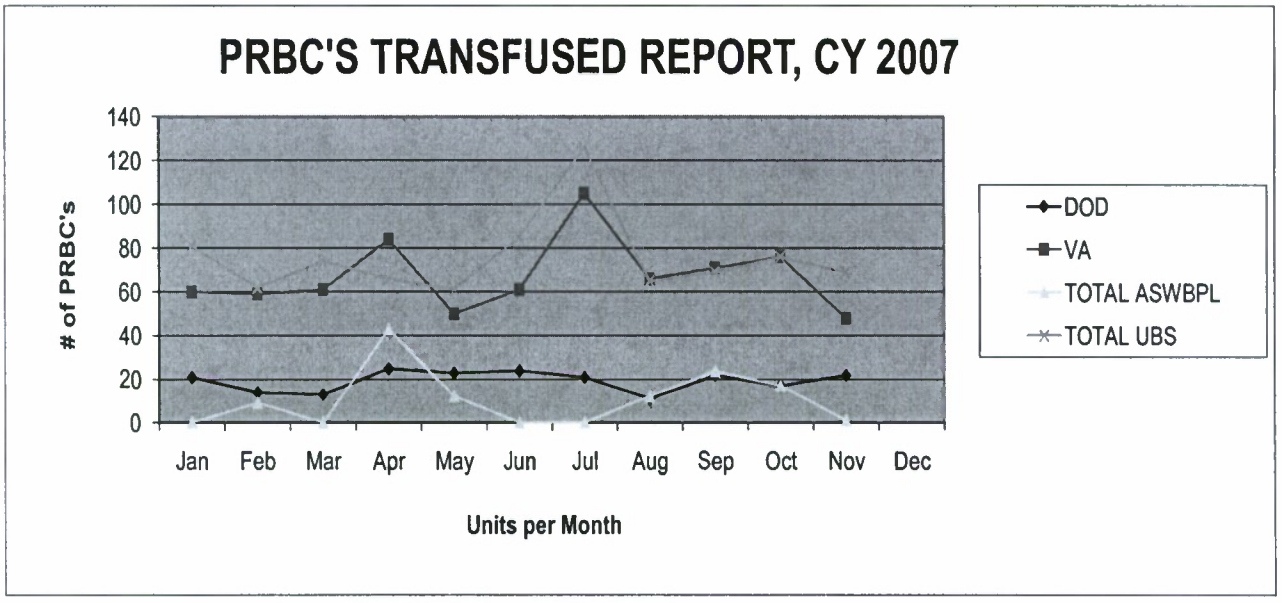
Reviewer: XXXXXXXXXX, Capt, USAF Date:

Reviewed by: _____ M/C Council _____ Surg Council _____ Med Council ____ ER/Fam Council

Appropriate _____ Inappropriate _____

Signed: _____ Date: _____
Council Chairperson

Appendix E – Red Blood Cell Donation and Disposition Breakdown



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
DOD	21	14	13	25	23	24	21	11	22	17	22	
VA	60	59	61	84	50	61	105	66	71	76	48	
TOTAL UNITS	81	73	74	109	73	85	126	77	93	93	70	
DOD (ASWBPL)	0	2	0	12	3	0	0	4	3	5	0	
VA (ASWBPL)	0	7	0	31	9	0	0	8	21	11	1	
DOD (UBS)	21	12	13	13	20	24	21	7	19	12	22	
VA (UBS)	60	52	61	53	41	61	105	58	50	65	47	

TOTAL ASWBPL	0	9	0	43	12	0	0	12	24	17	1	
TOTAL UBS	81	62	74	66	61	85	126	65	69	76	69	
% that came from ASWBPL	0%	15%	0%	65%	20%	0%	0%	18%	35%	22%	1%	16%

Appendix F – Indirect Cost Calculation, Salary Expenses

MONTHLY DATA OF AVAILABLE FTEs, HOURS, & SALARIES

Months	Workcenter: DBAA/DBBA Laboratory/Histo											
	Avail FTEs Providers/Nurses	Per Day	Avail Hours	Per Day	Avail Salaries	Per Day	Avail FTEs Techs	Per Day	Avail Hours	Per Day	Avail Salaries	Per Day
Dec 08	2.63	0.02	441	2.63	31,480	1,015	26	0.15	4,445	26.46	129,284	4,170
Jan 09	3.69	0.02	622	3.7	42,579	1,373	22	0.13	3,771	22.44	106,021	3,420
Feb 09	4.9	0.03	651	3.88	42,017	1,500	25.5	0.15	4,283	25.49	113,878	4,067
							74		12,499	26	349,183	7,590
											Avg Hourly Expense	$ 27.93
	Workcenter: DFBA Operating Room											
	Avail FTEs Providers/Nurses	Per Day	Avail Hours	Per Day	Avail Salaries	Per Day	Avail FTEs Techs	Per Day	Avail Hours	Per Day	Avail Salaries	Per Day
Dec 08	8	0.04	1,272	0.73	56,799	1,832	14	0.08	2,436	15	45,306	1,461
Jan 09	7.89	0.05	1,325	7.89	68,868	2,221	15	0.08	2,538	15	47,268	1,525
Feb 09	8.04	0.05	1,351	8.04	66,640	2,380	14	0.08	2,390	14	45,883	1,639
	24		3,948	0	192,307	6,433						
					Average Hourly Expense	$ 48.42						

Computation for Per Day Avail FTEs and Avail Hours: xx divided 168.
Computation for Per Day Avail Salary: xxx divided by 31 or 28 days.

Source: EASIV Personnel Accepted Report

Appendix G – Case Analysis, Scenario 1

Scenario 1

Procedure	# Procedures/year	Avg Blood Req/Proc	Total Requirement	Projected Reduction in Reqt Using Blood Mgmt Techniques	Calculated Cost per (RBC) Unit Direct/Indirect Costs	Total Cost
Total Hip Replacement	15	0.25	3.75	0.375	$ 337.27	$ 126.48
Prostatectomy	1	7	7	2	$ 337.27	$ 674.54
Hysterectomy	2	0.5	1	0	$ 337.27	$ -
					Total Cost of Blood Rquirements	$ 801.02

implementation Costs		Equipment Cost	Supplies	Personnel (1 hour OR time x # procedures)
	ANH	NA	250	774.72
	Cell Saver	NA	NA	774.72
	Patient Autoiogous Donation	No longer recommended for use at MOFH		
			Total	1799.44

Elimination of PAD units

	Usage	Wastage
2006	20	5
2007	17	10
2008	10	1
Total	47	16

Average Waste 34%

PROJECTIONS		Average Waste	Projected Waste	Cost Per Unit**	Cost Savings
2009	16	34%	5	$ 323.35	$1,722.38
2010	14	34%	5	$ 336.28	$1,626.12
2011	13	34%	5	$ 349.74	$1,581.06
				Total Savings 2009-2011	$4,929.56

Appendix H – Case Analysis, Scenario 2

	Historical Workload RBC	Costs per Unit ** (UBS)	Costs per Unit ** (ASWBPL)		Historical Workload PLT	Costs per Unit ** (UBS)		Historical Workload FFP	Costs per Unit ** (UBS)	
CY06	1295	$ 337.27	$ 186.35	$ 405,494.03	91	$ 678.35	$ 61,729.85	352	$ 156.35	$ 55,035.20
CY07	1287	$ 337.27	$ 186.35	$ 402,989.04	221	$ 678.35	$ 149,915.35	160	$ 156.35	$ 25,016.00
CY08	1283	$ 337.27	$ 186.35	$ 316,539.19	125	$ 678.35	$ 84,793.75	226	$ 156.35	$ 35,335.10
	Projected Demand RBC	Costs Per Unit (Projected)	ASWBPL Cost Per Unit (Projected)		Projected Demand PLT	Costs Per Unit (Projected)		Projected Demand FFP	Costs Per Unit (Projected)	
CY09	1288	$ 337.27	$ 186.35	$ 337,298.55	146	$ 678.35	$ 98,812.98	246	$ 156.35	$ 38,462.10
CY10	1286	$ 350.76	$ 186.35	$ 345,392.08	164	$ 678.35	$ 111,174.03	211	$ 173.55	$ 36,560.88
CY11	1286	$ 364.79	$ 186.35	$ 354,332.78	145	$ 678.35	$ 98,260.25	228	$ 192.64	$ 43,836.04

Elimination of Inappropriate Transfusions

	Projected Demand	Projected Fallout	Projected Inappropriate	Cost per unit	Projected Savings
CY09	1287	16%	103	$ 337.27	$ 34,718.66
CY10	1286	16%	77	$ 350.76	$ 27,069.47
CY11	1286	16%	77	$ 364.79	$ 28,153.09

Projected Demand	Projected Fallout	Projected Inappropriate	Cost per unit	Projected Savings
146	6%	9	$ 678.35	$ 5,928.78
164	6%	10	$ 678.35	$ 6,670.44
145	6%	9	$ 678.35	$ 5,895.62

Projected Demand	Projected Fallout	Projected Inappropriate	Cost per unit	Projected Savings
246	6%	15	$ 156.35	$ 2,307.73
211	6%	13	$ 173.55	$ 2,197.12
228	6%	14	$ 192.64	$ 2,635.30

Projected Cost Savings			
Elimination of Inappropriate Transfusions	**2009**	**2010**	**2011**
RBC	$ 34,718.66	$ 27,069.47	$ 28,153.09
PLT	$ 5,928.78	$ 6,670.44	$ 5,895.62
FFP	$ 2,307.73	$ 2,197.12	$ 2,635.30
Total	$ 42,955.16	$ 35,937.03	$ 36,684.00

Appendix I – Glossary of Terms

Allogeneic blood - Blood donated from another individual, which is typically stored and then provided through a transfusion. Jehovah's Witnesses do not accept allogenic blood

Cell savers - Devices that capture and hold blood during or after surgery, so that the blood can be returned to the patient.

Erythropoeitin - Erythropoietin is the name of a chemical normally produced by your body, primarily by your kidneys. Erythropoietin stimulates the bone marrow to produce red blood cells. Laboratory-made synthetic erythropoietin (e.g., Procrit, Epoetin alfa, Epogen, or Aranesp) may be administered prior to a surgical procedure in order to maximize your bone marrow's production of red blood cells.

Hemodilution - The process of making blood more dilute than normal. The result is that when A patient bleeds during surgery, the diluted blood contains a lower concentration of red blood cells.

Hemostatic – To stop bleeding

Normovolemia - All people maintain a particular volume of fluid circulating throughout their bodies; this is referred to as "normovolemia." During surgery, a patient will be given balanced intravenous solutions (volume expanders) to replace the fluids, salts, and sugars that are invariably lost during the course of surgery.

Type and Crossmatch - The blood bank staff perform all necessary testing on the patient's sample and crossmatch the number of units requested. In the blood bank, these units will be set aside for the patient and are immediately available once the physician determines there is a need to transfuse the patient

Type and Screen - The blood bank staff will perform all necessary testing on the patient's

sample. Until a request is received for blood, units will not be crossmatched and set aside in the blood bank for that patient. However, once a request for blood is received, blood can be made available in as little as five minutes. This order is generally used when the likelihood of the patient needing a blood transfusion is slight.